Contents

Preface vii

Photograph ix

Opening Address xi

Committees xiii

Section I. Invited Papers

Latest results from JET, *The JET Team* 3

Review of high Z materials for PSI applications, *T. Tanabe, N. Noda and H. Nakamura* 11

Experiments on TFTR supershot plasmas, *J.D. Strachan, M. Bell, A. Janos, S. Kaye, S. Kilpatrick, D. Manos, D. Mansfield, D. Mueller, K. Owens, C.S. Pitcher, J. Snipes and J. Timberlake* 28

Helium transport in enhanced confinement regimes on the TEXTOR and DIII-D Tokamaks, *D.L. Hillis, J.T. Hogan, K.H. Finken, W.P. West, R.R. Weynants, M.R. Wade, K. Akaishi, W.Y. Baek, J. Boedo, K.H. Burrell, R.W. Conn, K.H. Dippel, R. Doerner, H. Euringer, D. Finkenthal, D.S. Gray, C.M. Greenfield, P. Gohil, R.J. Groebner, J. Kim, C.C. Klepper, A.M. Messiaen, P.K. Mioduszewski, A. Miyahara, R. Moyer, G. Van Oost, A. Pospieszczyk, D. Reiter, D. Rusbüldt, R.P. Seraydarian, R. Van Nieuwenhove and G.H. Wolf* 35

Liquid-metal tokamak divertors, *S.V. Mirnov, V.N. Dem'yanenko and E.V. Murav'ev* 45

The status of ITER divertor design concepts, *S.A. Cohen, K.A. Werley, M.F.A. Harrison, V. Pistunovitch, A. Kukushkin, S. Krashenninikov, M. Sugihara, L.J. Perkins, R. Bulmer, D.E. Post, J. Wesley and the ITER Team* 50

Transport in the plasma edge and specific connexion to the wall in the Tore Supra ergodic divertor experiments, *A. Grosman, P. Ghendrih, C. DeMichelis, P. Monier-Garbet, J.-C. Vallet, H. Capes, M. Chatelier, T.E. Evans, A. Géraud, M. Goniche, C. Grisolia, D. Guilhem, G. Harris, W. Hess, F. Nguyen, L. Poutchy and A. Samain* 59

Impurity generation mechanism and remote radiative cooling in JT-60U divertor discharges, *H. Kubo, M. Shimada, T. Sugie, N. Hosogane, K. Itami, S. Tsuji, H. Nakamura, N. Asakura, A. Sakasai, Y. Kawano and the JT-60 Team* 71

Progress in two-dimensional plasma edge modelling, *D. Reiter* 80

Edge turbulence in tokamaks, *A.V. Nedospasov* 90

The impact of boundary plasma conditions on the plasma performance of the Wendelstein 7-AS stellarator, *P. Grigull, R. Behrisch, R. Brakel, R. Burhenn, A. Elsner, H. Hacker, H.J. Hartfuss, G. Herre, D. Hildebrandt, R. Jaenicke, J. Kisslinger, H. Maassberg, C. Mahn, H. Niedermeyer, P. Pech, H. Renner, H. Ringler, F. Rau, J. Roth, F. Sardei, U. Schneider, F. Wagner, A. Weller, H. Wobig, H. Wolff, the W7-AS Team, the NBI Team and The ECRH Group* 101

Reflection of low energy plasma ions from metal surfaces, *J.W. Cuthbertson, W.D. Langer and R.W. Motley* 113

Summary of ITER Panel Discussions, *R.R. Parker* ... 129

Section II. Oral Paper Session

Power scaling of divertor plasma conditions during H-mode in DIII-D, *D. Buchenauer, J.W. Cuthbertson, D.N. Hill, C. Klepper and T.W. Petrie* 133

Hydrogen, deuterium, and tritium isotope exchange experiments in JET, *L.D. Horton, P. Andrew, G. Bracco, S. Conroy, S. Corti, J. Ehrenberg, D.H.J. Goodall, O.N. Jarvis, P. Lomas, M. Loughlin, A.T. Peacock, G. Saibene, G. Sadler, R. Sartori, M.F. Stamp, P.R. Thomas and P. van Belle* 139

The tritium cleanup experiment in JET, *P. Andrew, C.J. Caldwell-Nichols, J.P. Coad, K.J. Dietz, J. Ehrenberg, D.H.J. Goodall, J. Hemmerich, L. Horton, J. How, R. Lasser, P. Lomas, M. Loughlin, G.M. McCracken, A. Peacock, G. Saibene, R. Sartori, P. Thomas and T. Winkel* 143

Evaluation of tungsten as a plasma-facing material for steady state magnetic fusion devices, *Y. Hirooka, M. Bourham, J.N. Brooks, R.A. Causey, G. Chevalier, R.W. Conn, W.H. Eddy, J. Gilligan, M. Khandagle and Y. Ra* 149

Superpermeability to fast and thermal hydrogen particles: applications to the pumping and recycling of hydrogen isotopes, *A.I. Livshits, M.E. Notkin, A.A. Samartsev, A.O. Busnyuk, A.Yu. Doroshin and V.I. Pistunovich* 159

Control of impurity and hydrogen–deuterium dilution by wall conditioning in JT-60U, *M. Shimada, A. Sakasai, R. Yoshino, Y. Kamada, H. Kubo, T. Sugie, S. Tsuji, H. Nakamura, M. Nemoto, Y. Koide, H. Ninomiya and H. Horiike* 164

Surface analysis of JT-60 graphite divertor tiles, *I. Fujita, S. Amemiya, T. Hino, T. Yamashina, M. Akiba, T. Ando and M. Seki* 168

Electron temperature and electron density profiles measured with a thermal He-beam in the plasma boundary of TEXTOR, *B. Schweer, G. Mank, A. Pospieszczyk, B. Brosda and B. Pohlmeyer* 174

Velocity distribution of carbon and oxygen atoms in front of a tokamak limiter, *P. Bogen and D. Rusbüldt* 179
Ellipsometry as a diagnostic for the measurement of erosion and redeposition in a tokamak, *S.J. Davies and R.D. Monk* 184
Comparison of collector probe measurements of sputtered copper fluxes from the ASDEX divertor plate with a two-dimensional computer simulation, *S. Adamson, E. Taglauer, G. Fussmann, H.R. Yang, J. Roth and the ASDEX Team* 189
Effect of boundary conditions on the neutral gas temperatures and densities in the ITER divertor and pump duct, *D.N. Ruzic and D.R. Juliano* 194
Studies of fuelling rates of CO, CH_4 and oxygen in the TEXTOR tokamak, *G.M. McCracken, U. Samm, B. Bertschinger, V. Philipps, R.A. Pitts, D.H.J. Goodall, S.J. Davies, G. van Oost, A. Pospieszczyk, R. Schorn, B. Schweer, P.C. Stangeby, G. Telesca and G. Waidmann* 199
The effect of ELMs on edge plasma scaling in DIII-D, *D.N. Hill, A. Futch, A.W. Leonard, M.A. Mahdavi, T.W. Petrie, D. Buchenauer, R. Campbell, J.W. Cuthbertson, J. Watkins and R. Moyer* 204
Understanding atomic hydrogen behaviour in pumped divertor plasmas, *K. Uchino, H. Takenaga, T. Kajiwara, T. Okada, K. Muraoka, M. Maeda, H. Iguchi, K. Ida, S. Okamura, H. Yamada, K. Matsuoka and the CHS group* 210
Optimising X-point target plates, *M.A. Pick, E. Deksnis, K.J. Dietz, C. Lowry, W. Parsons and R. Tivey* 215
Measurements of the edge power flow to the ALT-II limiter in TEXTOR, *K.H. Finken, W.Y. Baek, K.H. Dippel, J.A. Boedo, D.S. Gray and G. Mank* 220
Retention of intrinsic gases in TdeV's biasable divertor, *B. Terreault, P. Couture, C. Liu-Hinz, B.C. Gregory, E. Haddad, H.H. Mai, F. Martin, B.L. Stansfield, C. Janicki and J.-L. Lachambre* 226
Plasma discharge fuelling by reactive gases, *H.G. Esser, J. Winter, V. Philipps, H.B. Reimer, J. von Seggern, P. Wienhold and the TEXTOR team* 231
Boronization in DIII-D, *G.L. Jackson, J. Winter, K.H. Burrell, J.C. DeBoo, C.M. Greenfield, R.J. Groebner, T. Hodapp, K. Holtrop, A.G. Kellman, R. Lee, S.I. Lippmann, R. Moyer, J. Phillips, T.S. Taylor, J. Watkins and W.P. West* 236
Plasma fluxes to surfaces for an oblique magnetic field, *C.S. Pitcher, P.C. Stangeby, M.G. Bell, J.D. Elder, S.J. Kilpatrick, D.M. Manos, S.S. Medley, D.K. Owens, A.T. Ramsey and M. Ulrickson* 241
Measurement of flow in the scrape-off layer of TdeV, *C.S. MacLatchy, C. Boucher, D.A. Poirier, J.P. Gunn, B.L. Stansfield and W.W. Zuzak* 248
Plasma ion mass spectrometry in the TEXTOR boundary, *G.F. Matthews, D. Elder, G.M. McCracken, R.D. Monk, R.A. Pitts, U. Samm, B. Schweer and P.C. Stangeby* 253
Calculation of observable quantities using a divertor impurity interpretive code, DIVIMP, *P.C. Stangeby and J.D. Elder* 258
Particle and energy transport scalings in the ASDEX scrape-off layer, *K. McCormick, G. Kyriakakis, J. Neuhauser, E. Kakoulidis, J. Schweinzer and N. Tsois* 264
An analytical erosion model for divertor plates and limiter experiments in CHS, *A. Sagara, N. Noda, R. Akiyama, H. Arimoto, H. Idei, H. Iguchi, O. Kaneko, T. Kohmoto, S. Kubo, N. Matsunami, K. Matsuoka, S. Morita, O. Motojima, K. Nishimura, S. Okamura, J. Rice, T. Shoji, C. Takahasi, Y. Takita, M. Ueda, H. Yamada and I. Yamada* 271
Helical divertor in the large helical device, *N. Ohyabu, N. Noda, H. Ji, H. Akao, K. Akaishi, T. Ono, H. Kaneko, T. Kawamura, Y. Kubota, S. Morimoto, A. Sagara, T. Watanabe, K. Yamazaki and O. Motojima* 276
Plasma wall particle balance in Tore Supra, *C. Grisolia, Ph. Ghendrih, B. Pégourié and A. Grosman* 281
Deposition and in-depth penetration of deuterium in carbon fibre composites, *M. Rubel, B. Emmoth, H. Bergsåker, P. Wienhold, V. Dunaev and V. Sukhomlinov* 285
Edge plasma and fluctuations in TFTR, *H.Y.W. Tsui, D.M. Manos, A. Rudyj, Ch.P. Ritz and A.J. Wootton* 292
Effects of ergodization on plasma confinement in JFT-2M, *T. Shoji, H. Tamai, Y. Miura, M. Mori, H. Ogawa, A.W. Leonard, T. Jensen, A.W. Hyatt, A.M. Howald, G. Fuchs, N. Ohyabu, N. Asakura, T. Fujita, M. Shimada, S. Tsuji, H. Maeda, H. Aikawa, K. Hoshino, S. Kasai, T. Kawakami, H. Kawashima, M. Maeno, T. Matsuda, T. Ogawa, T. Seike, N. Suzuki, K. Uehara, T. Yamamoto, T. Yamauchi, T. Hamano, K. Hasegawa, A. Honda, M. Kazawa, Y. Kashiwa, K. Kikuchi, H. Okano, E. Sato, N. Seki, T. Shibata, T. Shiina, S. Suzuki, T. Tani, T. Tokutake, Y. Tomiyama and T. Yamasato* 296

Section III. Poster Session A

Plasma edge phenomena, impurities and alternate concepts

Impurity behavior in Heliotron E, *K. Kondo, T. Mizuuchi, H. Matsuura, F. Sano, S. Sudo, H. Zushi, H. Okada, S. Besshou, K. Nagasaki, S. Higashijima, Y. Kurimoto, M. Wakatani and T. Obiki* 303
Effects of limiter biasing on the ATF torsatron, *T. Uckan, S.C. Aceto, L.R. Baylor, J.D. Bell, T.S. Bigelow, A.C. England, J.H. Harris, R.C. Isler, T.C. Jernigan, J.F. Lyon, C.H. Ma, P.K. Mioduszewski, M. Murakami, D.A. Rasmussen, J.B. Wilgen and J.J. Zielinski* 308
Experiments with a biased pump limiter on the HL-1 tokamak, *G.D. Li, X.D. Gong, Y.X. Xu, W.D. Fu, Z.G. Xiao, J.L. Luo, Z.T. Liu, K.H. Li, L.B. Ran, S.Q. Sun, E.Y. Wang, S.K. Yang, Y.X. Jiang, Z.Y. Cui, H.R. Yang, L.H. Yao and L.H. Zheng* 312
Modification of the plasma edge properties during divertor plate biasing experiments on TdeV, *D. Michaud, G.G. Ross, B.L. Stansfield, F. Schiettekatte, P. Couture and C. Boucher* 316
Impurity screening in high density plasmas in tokamaks with a limiter configuration, *C. Ferro and R. Zanino* 321
Finite element fluid modeling of axisymmetric magnetized boundary plasma with recycling neutrals, *R. Zanino* 326
Particle fluxes and impurities in EXTRAP T1 from surface probes and spectroscopy, *I. Gudowska, H. Bergsåker, K.-D. Zastrow, P. Brunsell, J. Drake, B. Emmoth, G. Hellblom and P. Hörling* 332

A first flight corrected neutral diffusion model for edge plasma simulation, *A.K. Prinja and C. Koesoe-modiprodjo* 340
A fully implicit, time dependent 2-D fluid code for modeling tokamak edge plasmas, *T.D. Rognlien, J.L. Milovich, M.E. Rensink and G.D. Porter* 347
NEWEDGE: a 2D fully implicit edge plasma fluid code for advanced physics and complex geometries, *D.A. Knoll and P.R. McHugh* 352
Production of high density plasma and study on the influence of a nonuniform magnetic field on the particle transport in the SOL region, *S. Tanaka, T. Ohira and K. Nakamura* 357
Kinetically motivated boundary conditions for fluid models of scrape-off layer transport, *R.J. Procassini and D.A. Knoll* 363
Modelling impurity control at JET, *R. Simonini, A. Taroni, M. Keilhacker, G. Radford, J. Spence, G. Vlases, M.L. Watkins and S. Weber* 369
Impurity profiles at the JET divertor targets compared with the DIVIMP code, *G.F. Matthews, P.C. Stangeby, J.D. Elder, N.A.C. Gottardi, P.J. Harbour, L.D. Horton, H.J. Jackel, L. de Kock, A. Loarte, C.F. Maggi, D.P.J. O'Brien, R. Simonini, J. Spence, M.F. Stamp, P.E. Stott, H.P. Summers, J. Tagle and M. von Hellerman* 374
Divertor performance on carbon and beryllium targets in JET, *G. Janeschitz, R. König, L. Lauro-Taroni, J. Lingertat, G. Matthews, M. Stamp, G. Vlases, D. Campbell, S. Clement, L. De Kock, W. Eckstein, J. Ehrenberg, N. Gottardi, P. Harbour, L. Horton, H. Jäckel, M. Lesourd, A. Loarte, C. Lowry, J. Roth, G. Saibene, D. Summers, J.A. Tagle, P.R. Thomas and M. von Hellermann* 380
A new approach to scaling of the scrape-off layer and divertor plasma in JET, *P.J. Harbour, A. Loarte, S. Clement, L. de Kock, H.J. Jäckel, M. Lesourd, D.P. O'Brien, D.D.R. Summers and J.A. Tagle* 386
Comparison of measured JET divertor performance with edge models, *G. Vlases, G. Janeschitz, G. Matthews, G. Radford, R. Simonini, A. Taroni, D. Campbell, S. Clement, P. Harbour, L. Horton, M. Keilhacker, L. de Kock, D. O'Brien, J. Spence, M. Stamp, D. Summers, J. Tagle, P. Thomas, M. von Hellerman and M. Watkins* 392
Impurity edge transport in the vicinity of the beryllium belt limiters in JET, *A. Hwang, J.D. Elder, D.H.J. Goodall, G.M. McCracken, P.C. Stangeby and D.D.R. Summers* 398
Experimental investigation of ELMs and associated fluctuations in JET, *A.L. Colton, S. Ali-Arshad, P. Cripwell and L. Porte* 404
Probe edge measurements in JET X-point plasmas for various heating and plasma conditions, *J.A. Tagle, S. Clement, A. Loarte, L. de Kock, P.J. Harbour, D. O'Brien, S.K. Erents, G. Janeschitz, C. Nicholson and J. Vince* 409
Behavior of impurities in the scrape-off layer under long duration discharges in TRIAM-1M, *N. Yoshida, K. Tokunaga, T. Fujiwara, K. Tawara, T. Muroga, S. Itoh and the TRIAM-group* 415
Magnetic perturbation effects on boundary plasmas during high power lower hybrid current drive in Tore Supra, *T.E. Evans, M. Goniche, A. Grosman, D. Guilhem, W. Hess and J.-C. Vallet* 421
Scrape-off layer modeling of radiative divertor and high heat flux experiments on DIII-D, *R.B. Campbell, T.W. Petrie and D.N. Hill* 426
Bulk-boronized limiter operation in the Wendelstein 7-AS stellarator, *R. Brakel, R. Burhenn, R. Behrisch, P. Grigull, H. Hacker, D. Hildebrandt, Y. Hirooka, J.V. Hofmann, C. Mahn, J. Roth, U. Schneider, A. Weller, W7-AS Team, NI Group and ECRH Group* . 431
Impurity collection in the SOL plasma and at the wall of W7-AS, *D. Hildebrandt, H. Wolff, J. Roth, R. Brakel, P. Grigull, F. Rau, F. Sardei, E. Taglauer, W7-AS Team, NBI-Group and ECRH-Group* 436
Transport study on the boundary plasma of the Wendelstein 7-AS stellarator, *F. Sardei, P. Grigull, G. Herre, D. Hildebrandt, P. Pech, U. Wenzel, H. Wolff, W7-AS Team and ECRH Group* 443
Bifurcation phenomena in an emissive plate – simulated divertor plasma system, *S. Takamura, N. Ohno, K. Shiraishi and S. Masuzaki* 448
Control of edge electric field by limiter biasing and electron beam injection in HYBTOK-II tokamak, *Y. Uesugi, Y. Yamakawa, T. Chiba and S. Takamura* 452
Scaling of divertor conditions in next step devices with divertor depth and upstream plasma conditions, *H.D. Pacher, W.D. D'haeseleer and G.W. Pacher* . . 457
Particle balance in a TFTR supershot, *R.V. Budny, D. Coster, D. Stotler, M.G. Bell, A.C. Janos and D.K. Owens* 462
Assessment of critical physical assumptions in consistent 2D plasma edge modelling, *M. Baelmans, D. Reiter, H. Kever, P. Börner, M.W. Wuttke, Th. Pütz, R. Schneider, G.P. Maddison, B.J. Braams and R.R. Weynants* 466
Impurity profiles and transport characteristics in JT-60U, *A. Sakasai, Y. Koide, H. Kubo, T. Sugie, M. Shimada, T. Hirayama, N. Asakura, Y. Kawano, N. Hosogane and H. Nakamura* 472
Transport analysis of divertor plasma in JT-60U, *K. Shimizu, K. Itami, H. Kubo, N. Asakura and M. Shimada* 476
Elastic backscattering of hydrogen molecules from a plasma, *G. Haas, P. Bachmann, D. Düchs, R. Reichle, D. Reiter and R. Schneider* 481
Impurity screening in Tore Supra, *C. De Michelis, Ph. Ghendrih, C. Grisolia, A. Grosman, W. Hess, M. Mattioli and P. Monier-Garbet* 485
Flows in the TEXTOR SOL and edge plasma, *J. Boedo, D.S. Gray, G.R. Tynan, R. Pitts, K.H. Dippel, K.H. Finken and R. Conn* 489
Investigation of recycling in the GAMMA 10 tandem mirror, *Y. Nakashima, K. Yatsu, K. Tsuchiya, M. Ichimura, N. Yamaguchi, M. Inutake, M. Shoji, K. Ohtoshi, T. Tamano and S. Miyoshi* 493
Impurity penetration and transport during VH-mode on DIII-D, *S.I. Lippmann, T.E. Evans, G.L. Jackson and W.P. West* 498
Impurity behavior in high-β plasmas in PBX-M, *S.F. Paul, R.J. Fonck, R.C. Isler and S. Sesnic* 503
Noble gas pumping by the TFTR graphite limiter, *A.T. Ramsey and D.M. Manos* 509
Analysis of erosion and transport of carbon impurity in

the TFTR inner bumper limiter region, *T.Q. Hua and J.N. Brooks* 514
Hydrogen recycling and its control on HL-1 tokamak, *L. Peng, C. Yan, Z. Cao, K. Huang, Y. Zheng, S. Qian and J. Luo* 520

Section IV. Poster Session B
Materials, conditioning, disruptions, and helium

AC discharge carbonization in HL-1 tokamak, *L.H. Yao, D.H. Yan, W.Y. Hong, Z. Cao, C.H. Cui, S.X. Zhang, K.H. Li, J.L. Lou, Z.C. Deng, M.L. Shi, L.B. Ran, S.G. Sun and Y.Z. Zheng* 527
Evaluation for boron mixed graphite and high Z metal as plasma facing material, *T. Hino and T. Yamashina* 531
Numerical simulation of vapor shielding and range shortening for ions impinging on a divertor during plasma disruptions, *W. Höbel, B. Goel, M. Küchle and H. Würz* 537
Test of the boron containing coating of the graphite limiter in the T-10 tokamak, *V.A. Barsuk, O.I. Buzhinskiy, V.A. Vershkov, S.A. Grashih, V.M. Gureev, M.I. Guseva, V.E. Neumoin, I.V. Opimach, E.N. Kurolenkin, R.U. Mametiev, E.V. Tupizina and V.N. Sharupin* 543
Film deposition on metallic surfaces at liquid nitrogen temperature in view of the conditioning of FTU vacuum chamber, *M.L. Apicella, A. Neri and L. Verdini* 549
Analysis of a-C/B:H layers deposited in TdeV, *R.W. Paynter, G.G. Ross, C. Boucher, J.F. Pageau and B. Stansfield* 553
Low energy helium implantation in evaporated nickel surfaces, *R.E. Nygren, B.L. Doyle, D.S. Walsh, W. Ottenberger, J.N. Brooks and A. Krauss* 558
Flux dependence of metal sputtering from metal–carbon composite materials in the high temperature regime, *K. Morita, K.-i. Mori and Y. Muto* 564
Erosion of tungsten by self-sputtering and light ion irradiation at oblique angles of incidence, *C.H. Wu and E. Hechtl* 569
Chemical sputtering of pyrolytic graphite and boron doped graphite USB15 at energies between 10 and 1000 eV, *C. García-Rosales and J. Roth* 573
Particle and energy balance in the SOL generated by a limiter in a RFP plasma, *V. Antoni, M. Bagatin, D. Desideri and G. Serianni* 577
Synergistic erosion of graphite due to simultaneous bombardment by C^+ and H^+, *J.W. Davis, A.A. Haasz and C.H. Wu* 581
Comparison of three boronization techniques in TdeV, *C. Boucher, F. Martin, B.L. Stansfield, B. Terreault, G. Abel, A. Boileau, P. Brooker, P. Couture, A. Côté, R. Décoste, B.C. Gregory, E. Haddad, C. Janicki, J. Kalnavarns, E. Knystautas, J.L. Lachambre, D. Lafrance, G. Le Clair, C.S. MacLatchy, H.H. Mai, D. Michaud, R. Neufeld, R.W. Paynter, D. Pinsonneault, D. Poirier, B. Quirion, G. Ratel, N. Richard, G.G. Ross, M. St-Onge, A. Sarkissian, D. Whyte, W. Zuzak, Y. Hirooka, R.W. Conn, T. Matsuda, H.G. Esser and J. Winter* 587
Surface segregation of a low-Z element and its impact on interaction with hydrogen, *M. Yamawaki, K. Yamaguchi, S. Tanaka, X. Liu and J.P. Qian* 592
Vapor shield protection of plasma facing components under incident high heat flux, *J. Gilligan, M. Bourham, O. Hankins, W. Eddy, J. Hurley and D. Black* 596
Power loading on the first wall during disruptions in TFTR, *A. Janos, E.D. Fredrickson, K.M. McGuire, Y. Nagayama, D.K. Owens and E. Wilfrid* 602
Simulation of disruptions on coatings and bulk materials, *J. Linke, M. Akiba, H. Bolt, J. van der Laan, H. Nickel, E. van Osch, S. Suzuki and E. Wallura* 607
Effects of short pulse high heat fluxes on carbon base plasma facing materials for ITER, *J.G. van der Laan, H.Th. Klippel, G.J. Kraaij, R.C.L. van der Stad, J. Linke and M. Akiba* 612
In situ boron nitride coating and comparison with existing boronizations, *M. Yamage, T. Ejima, H. Toyoda and H. Sugai* 618
Influence of B_2H_6/CH_4 and $B(CH_3)_3$ as process gas on boron carbide coatings: an in situ photoelectron spectroscopy study, *H. Künzli, P. Gantenbein, R. Steiner and P. Oelhafen* 622
High heat flux experiment on B_4C-overlaid C/C composites for plasma facing materials of JT-60U, *K. Nakamura, M. Akiba, S. Suzuki, K. Yokoyama, M. Dairaku, T. Ando, R. Jimbou, M. Saidoh, K. Fukaya, H. Bolt and J. Linke* 627
Helium exhaust in plasmas with strong radiative edge cooling, *U. Samm, J. Boedo, G. Bertschinger, K.H. Dippel, H. Euringer, K.H. Finken, D. Gray, D. Hillis, A. Pospieszczyk, D. Reiter, M. Tokar and B. Unterberg* 633
Boronization in Tore Supra, *E. Gauthier, C. Grisolia, A. Grosman, W. Hess, T. Hutter, C. De Michelis, P. Monier-Garbet, L. Poutchy and J. Roth* 637
Hydrogen/deuterium recycling and initial results of helium ash study in JT-60U, *H. Nakamura, A. Sakasai, M. Shimada, R. Yoshino, T. Arai, T. Fukuda, T. Hirayama, N. Hosogane, S. Ishida, A. Kaminaga, Y. Koide, H. Kubo, T. Nishitani and T. Sugie* 642
Collection of oxygen in the scrape-off layer depending on boron conditioning of TEXTOR, *P. Wienhold, M. Rubel, J. von Seggern, H. Künzli, I. Gudowska and H.G. Esser* 647
Behavior of low-Z materials during plasma disruption simulated by laser beam, *J.P. Qian, P.Y. Li, L. Lu and X. Liu* 653
Implanted He retention and release from boronized layers, *B.L. Doyle, D.S. Walsh and W.R. Wampler* . 658
Summary of results from the TEXTOR helium self-pumping experiment, *J.N. Brooks, A. Krauss, R.E. Nygren, B.L. Doyle, K.H. Dippel and K.H. Finken* .. 664
Characterization of a-B/C:H films deposited from different boron containing precursors, *V.Kh. Alimov, D.B. Bogomolov, M.N. Churaeva, A.E. Gorodetsky, S.L. Kanashenko, A.I. Kanaev, S.Yu. Rybakov, V.M. Sharapov, A.P. Zakharov, R.Kh. Zalavutdinov, O.I. Buzhinsky, A.P. Chernobay, S.A. Grashin, S.V. Mirnov, V.I. Bregadze and A.Yu. Usyatinsky* 670
Vertical shift and current flow to limiters during dis-

ruptions in tokamaks, *A.V. Nedospasov, L.M. Bogomolov, N.M. Zykova, K.H. Dippel, K.H. Finken and G. Waidmann* 676
Dynamic modeling of plasma–vapor interactions during plasma disruptions, *A. Hassanein and D.A. Ehst* 680
Wall conditioning with impurity pellet injection on TFTR, *J.A. Snipes, E.S. Marmar, J.L. Terry, M.G. Bell, R.V. Budny, K.W. Hill, D.L. Jassby, D.K. Mansfield, D.M. Meade, H.K. Park, J.D. Strachan, B.C. Stratton, E.J. Synakowski, G. Taylor, the TFTR Group, D.N. Ruzic and M. Shaheen* 686
Results from the US/USSR exchange for heat load material studies of simulated disruptions, *J.M. Gahl, J.M. McDonald, J.F. Crawford, R. McGrath, A. Zakharov, S. Tserevitinov, V. Barabash and M. Guseva* 692
Edge plasma behavior induced by a biased electrode in the HL-1 tokamak, *G. Zhong, Y. Zheng, L. Ran, G. Li and Y. Fu* 696
Incident-angle dependence of secondary electron emission from hydrogen-implanted carbon surfaces, *K. Ohya, K. Nishimura, J. Kawata and I. Mori* 699
Evolution of CD_4 from bulk boronized graphite and B_4C during deuterium implantation, *B.M.U. Scherzer and V.Kh. Alimov* 703
Sputtering characteristics of B_4C-overlaid graphite for keV energy deuterium ion irradiation, *Y. Gotoh, T. Yamaki, T. Ando, R. Jimbou, N. Ogiwara, M. Saidoh and K. Teruyama* 708
Sputtering behavior of boron and boron carbide, *E. Hechtl, A. Mazanec, W. Eckstein, J. Roth and C. Garcia-Rosales* 713

Section V. Poster Session C
Plasma edge phenomena, divertors and limiters

"Natural" divertor- and limiter-discharges in Heliotron E, *T. Mizuuchi, H. Matsuura, K. Kondo, F. Sano, S. Sudo, H. Zushi, S. Besshou, H. Okada, K. Nagasaki, Y. Kurimoto, S. Higashijima and T. Obiki* 719
Optimization of the FTU toroidal limiter shape, *M. Ciotti, C. Ferro and G. Maddaluno* 725
Deuterium trapping and impurity collection on a 1990 JET Be belt limiter, *A.P. Martinelli, A.T. Peacock and R. Behrisch* 729
Results of JET operation with continuous carbon and beryllium X-point target plates, *C.G. Lowry, W.N. Ady, D.J. Campbell, P. Carman, S. Clement, E.B. Deksnis, A. Gondhalekar, P.J. Harbour, L. Horton, G. Janeschitz, M. Lesourd, J. Lingertat, M.A. Pick, G. Saibene, D.D.R. Summers and P.R. Thomas* . . . 735
Parallel currents in the scrape-off layer of JET diverted discharges, *A.V. Chankin, S. Clement, L. de Kock, S.K. Erents, P.J. Harbour and J.A. Tagle* 739
Sheath formation on carbon and refractory metals in a plasma with energetic electrons, *K. Shiraishi, N. Ohno, Y. Uesugi and S. Takamura* 745
Divertor phenomena prior to density limit disruptions in JT-60U, *N. Hosogane, N. Asakura, H. Kubo, K. Itami, A. Sakasai, K. Shimizu, H. Nakamura, M. Shimada, Y. Neyatani and R. Yoshino* 750
Characteristics of divertor plasma and scrape-off layer in JT-60U, *K. Itami, M. Shimada and N. Hosogane* 755
Actively cooled pump limiters and power scrape-off length measurements in Tore-Supra, *D. Guilhem, A. Seigneur, P. Chappuis, M. Chatelier, C. DeMichelis, P. Deschamps, A. Grosman, W. Hess, P. Lecoustey, T. Loarer, L. Poutchy and J. Schlosser* . . 759
ITER edge-plasma conditions versus pump configuration, *K.A. Werley* 765
Effects of radial electric fields on the turbulence and transport in the TEXTOR edge and SOL plasma, *G.R. Tynan, J.A. Boedo, D.S. Gray, R. Van Nieuwenhove, G. Van Oost and R.R. Weynants* 770
RF ponderomotive forces and electrostatic barriers for scrape-off layer control: phenomenological model, *A. Grossman, L. Schmitz, F. Najmabadi and R.W. Conn* 775
A second generation code for modeling tokamak edge plasmas, *M. Day, B. Merriman, F. Najmabadi and R.W. Conn* 785
Characterization of edge plasma and turbulence in the Phaedrus-T tokamak, *D. Diebold, N. Hershkowitz, J. Pew, J. Sorensen, T. Tanaka, H.Y.W. Tsui, Ch.P. Ritz and A.J. Wootton* 789
A data-base for edge turbulence and transport studies, *H.Y.W. Tsui, A.J. Wootton, J.D. Bell, R.D. Bengtson, D. Diebold, J.H. Harris, N. Hershkowitz, C. Hidalgo, J.C. Ingraham, G.X. Li, H. Lin, S.C. Luckhardt, D.M. Manos, M.A. Meier, G.M. Miller, C.P. Munson, J. Pew, Ch.P. Ritz, A. Rudyj, K.F. Schoenberg, J. Sorensen, T. Tanaka, T. Uckan and P.G. Weber* . . . 794
DIII-D edge physics data base, *R.A. Jong, G.D. Porter, D.N. Hill, D.A. Buchenauer and G. Bramson* 800
A design study for an advanced divertor for DIII-D and ITER: the radiative slot divertor, *S.L. Allen, M.E. Rensink, D.N. Hill, R. Wood, D. Nilson, B.G. Logan, R. Stambaugh, T.W. Petrie, G.M. Staebler, M.A. Mahdavi, R. Hulse and R.B. Campbell* 804
B2–EIRENE simulation of ASDEX and ASDEX-Upgrade scrape-off layer plasmas, *R. Schneider, D. Reiter, H.P. Zehrfeld, B. Braams, M. Baelmans, J. Geiger, H. Kastelewicz, J. Neuhauser and R. Wunderlich* 810
Simulation of electron transport in plasmas and solids, *A.P. Palov, V.V. Pletnev and V.B. Tel'kovskii* 816
Numerical study of divertor plasma transport with thermal force due to temperature gradient, *S. Ohtsu, S. Tanaka and M. Yamawaki* 819
Edge plasma control by rf electric field in the compact helical system (CHS), *T. Shoji, A. Sagara, N. Noda, M. Hosokawa, K. Ida, H. Idei, H. Iguchi, O. Kaneko, S. Kubo, K. Matsuoka, S. Morita, K. Nishimura, S. Okamura, C. Takahashi, Y. Takeiri and H. Yamada* 824
Scrape-off layer measurements in DIII-D, *J.G. Watkins, R.A. Moyer, D.N. Hill, D. Buchenauer, T.N. Carlstrom, R. Conn, J. Cuthbertson, R. Doerner, R. Lehmer, M.A. Mahdavi, R.T. McGrath, L. Schmitz and R. Stambaugh* 829
The edge fluctuations in H-mode like discharges induced by electrode biasing on the HL-1 tokamak, *Q. Yang, G. Zhong, Z. Wang, S. Yang, L. Ran, Y. Zheng and E. Wang* 833
Test of biased electrode as a technique to reduce ion flux from bulk plasma bombardment of antenna structures on the HL-1 tokamak, *J. Zhang, E.Y.*

Wang, Z.Y. Shang, L.H. Yao, H.R. Yang and Y.Z. Zheng 837
Impurity transport and retention in a gas target divertor: simulation experiments in PISCES-A and modeling results, *L. Schmitz, L. Blush, G. Chevalier, R. Lehmer, Y. Hirooka, P. Chia, G. Tynan and R.W. Conn* 841
Divertor heat flux reduction by D_2 injection in DIII-D, *T.W. Petrie, D. Buchenauer, D.N. Hill, C. Klepper, S. Allen, R. Campbell, A. Futch, R.J. Groebner, A. Leonard, S. Lippmann, M.A. Mahdavi, M. Rensink and P. West* 848
$E \times B$ transport in the DIII-D boundary plasma, *R.A. Moyer, J.G. Watkins, R.W. Conn, R. Doerner, D.N. Hill, R. Lehmer, R.T. McGrath, L. Schmitz, R.D. Stambaugh and G. Tynan* 854
Effects of neutral gas collisions on the power transmission factor at the divertor sheath, *A.H. Futch, G.F. Matthews, D. Buchenauer, D.N. Hill, R.A. Jong and G.D. Porter* 860
Simple models for evaluating the role of atomic processes in helium enrichment, *P. Bachmann, D. Reiter and A.K. Prinja* 865
Divertor materials evaluation system at DIII-D, *C.P.C. Wong, R. Junge, R.D. Phelps, P. Politzer, F. Puhn, W.P. West, R. Bastasz, D. Buchenauer, W. Hsu, J. Brooks and T. Hua* 871
Investigation of helium plasmas near material surfaces, *G.S. Chiu and S.A. Cohen* 876
A code for studying plasmas in contact with solids, *M. Petravic* 883
A scaling relation for the ITER scrape-off layer thermal diffusivity, *S.A. Cohen and Ö. Artun* 888
Scrape-off layer modeling using coupled plasma and neutral transport codes, *D.P. Stotler, D.P. Coster, B.J. Braams, A.B. Ehrhardt, C.F.F. Karney and M. Petravic* 894
Kinetic effects and reversal flows in the tokamak edge plasma, *S.I. Krasheninnikov, T.K. Soboleva, O.V. Batischev, G.I. Zmievskaya, V.D. Levchenko, P.A. Ovchenkov, Yu.S. Sigov and I.I. Silaev* 899
On boundary value problems for divertor plasmas, *Yu.L. Igitkhanov, V.A. Pozharov and A.M. Runov* . 904
Edge plasma phenomena of the low density plasma to high density transition in the HL-1 tokamak, *H.R. Yang, L.H. Yao, Y.Z. Zheng, E.Y. Wang, S.K. Yang, G. Yang, J.Y. Cao, G.Y. Diao, Z.C. Deng, J.F. Dong, G.C. Guo, Y.X. Jiang, C.X. Le, K.H. Li, H.Z. Li, L.B. Ran, M.L. Shi, Z.H. Wang, L.W. Yan, J.W. Yang, J. Zhang, S.X. Zhang, G.W. Zhong, Y.Z. Zhong and the HL-1 team* 908
Analytical studies of multidimensional plasma transport in the scrape-off layer, *M. Tendler and V. Rozhansky* 912
Interpretation of asymmetries in tokamak scrape-off layers in terms of poloidal variation of anomalous transport and diamagnetic effects, *J. Hugill* 918
Measurement of the edge plasma density profile in CHS by fast neutral lithium beam probing, *M. Ueda, H. Iguchi, S. Sasaki, J. Fujita and CHS Group* 923
Tokamak edge plasma densities measured by means of active lithium beam diagnostics, *F. Aumayr, R.P. Schorn, M. Pöckl, J. Schweinzer, E. Wolfrum, K. McCormick, E. Hintz and H. Winter* 928
Laboratory studies of spectroscopic markers for the characterization of surface erosion by plasmas, *D.M. Manos, T. Bennett, M. Herzer and J. Schwarzmann* . 933

Section VI. Poster Session D
Materials, fueling, and recycling, hydrogen on / in solids, and diagnostics

Helium and hydrogen isotope fuelling in tokamaks: similarities and differences, *M. Bessenrodt-Weberpals, O. Gehre, J. Hofmann, H. Murmann, G. Siller and ASDEX Team* 943
Numerical analysis of the plasma–material interaction during the thermal quench phase of tokamak disruptions, *H. Bolt, H. Harano, H. Madarame, K. Okamoto and H. Takabe* 948
Interaction of hydrogen atoms with beryllium (0001) surfaces, *V. Lossev and J. Küppers* 953
Retention of deuterium implanted into B_4C-overlaid isotropic graphites and hot-pressed B_4C, *R. Jimbou, M. Saidoh, N. Ogiwara, T. Ando, K. Morita and Y. Muto* 958
Isotopic effect in thermal re-emission of hydrogen from graphite at elevated temperatures, *K. Morita and Y. Muto* 963
Atomic re-emission of hydrogen from pure and boronized graphites at temperatures above 1000 K, *P. Franzen, E. Vietzke, A.A. Haasz, J.W. Davis and V. Philipps* 967
Molecule formation due to sequential and simultaneous exposure of graphite to H^+ and D^+, *S. Chiu and A.A. Haasz* 972
Tritium retention characteristics of several low-Z materials, *R.A. Causey, W.R. Wampler and O.I. Buzhinshij* 977
Trapping of deuterium in beryllium, *W.R. Wampler* .. 981
Hydrogen transport behavior of beryllium, *R.A. Anderl, M.R. Hankins, G.R. Longhurst, R.J. Pawelko and R.G. Macaulay-Newcombe* 986
Material related aspects of density control in JET plasma discharges, *J. Ehrenberg, P. Andrew, L. Horton, G. Janeschitz, L. de Kock and V. Philipps* 992
Interpretation of deuterium pumping by plasma-facing beryllium surfaces, *P.L. Andrew, A.T. Peacock and M.A. Pick* 997
Release of tritium from the JET vacuum vessel after high power discharges, *D.H.J. Goodall, P. Andrew, J. Ehrenberg, G.M. McCracken, A.T. Peacock, G. Saibene, R. Sartori and P. van Belle* 1002
Charged particle emission from plasma facing materials by high heat load, *K. Tokunaga, T. Fujiwara, S. Fukuda, T. Muroga and N. Yoshida* 1008
In situ study of microstructural evolution in molybdenum during irradiation with low energy hydrogen ions, *T. Muroga, R. Sakamoto, M. Fukui, N. Yoshida and T. Tsukamoto* 1013
Plasma density feedback control in the TEXT tokamak, *Y. Wong, G.A. Hallock, W.L. Rowan and A.J. Wootton* 1018
Thermodesorption studies of boron doped graphite exposed to a low energy high density deuterium

plasma, *V. Fernandez, J. Bardon, E. Gauthier and C. Grisolia* 1022
Ion temperature profiles from the plasma center to the edge of ASDEX combining high and low energy CX-diagnostics, *H. Verbeek, O. Heinrich, R. Schneider, H.-U. Fahrbach, W. Herrmann, J. Neuhauser, U. Stroth, the ASDEX team and D. Reiter* 1027
Electron density profile determination by means of laser blow-off injected neutral beam, *G. Kocsis, J.S. Bakos, P.N. Ignácz, B. Kardon, L. Koltai and G. Veres* 1032
Measurement of H energy and flux by H → D isotope exchange in JFT-2M scrape-off layer, *T. Nakajima, A. Kitamura, Y. Furuyama, N. Tani, M. Maeno and H. Maeda* 1036
Erosion of a-C:H films by He and Ne ion bombardment, *E. de la Cal, D. Tafalla and F.L. Tabares* ... 1041
Plasma boundary observations using an asynchronous CCD camera with automatic exposure control, *D.H.J. Goodall and M.N. Price* 1047
Measurements of secondary electron emission for fusion related materials, *J.M. Pedgley, G.M. McCracken, H. Farhang and B.H. Blott* 1053
Measurement and Monte Carlo computations of H_α profiles in front of a TEXTOR limiter, *D. Reiter, P. Bogen and U. Samm* 1059
Sputtering of amorphous C:H and C/B:H layers by argon ions, *E. Pasch, P. Bogen and Ph. Mertens* ... 1065
Particle balance and heat balance in JT-60U, *N. Asakura, M. Shimada, K. Itami, N. Hosogane, S. Tsuji, K. Shimizu, H. Kubo and H. Nakamura* 1069
Helium and hydrogen atom detection in the recycling gas using optical measurements on an ASDEX pressure gauge, *H.-S. Bosch, G. Haas and M. Lörcher* 1074
Effect of impurities on particle collection studies with a modular pump limiter on Tore Supra, *T. Loarer, T. Uckan, M. Chatelier, L.D. Horton and P.K. Mioduszewski* 1078
Modeling of core–wall particle dynamics in Tore Supra pumping experiments, *J. Hogan, P. Mioduszewski, L. Owen, T. Uckan, C. Klepper, M. Chatelier, Th. Loarer and L. Horton* 1083
Comparison of transient and stationary neutral pressure response in the DIII-D advanced divertor, *C.C. Klepper, J.T. Hogan, P.K. Mioduszewski, M. Ali Mahdavi, R. Maingi, L.W. Owen, M.J. Schaffer, D. Buchenauer, T.E. Evans, J.G. Gilligan, G. Haas, D.N. Hill, G.L. Jackson and T.W. Petrie* 1090
Particle exhaust above the ohmic density limit in TEXTOR, *D.S. Gray, J.A. Boedo, R.W. Conn, K.H. Dippel, K.H. Finken, R.A. Moyer, A. Pospieszczyk, D. Reiter, U. Samm, G.H. Wolf and the TEXTOR team* 1096
A new technique for in situ measurements of erosion and redeposition in a single discharge, *F. Weschenfelder, P. Wienhold and J. Winter* 1101
Behaviour of carbon and boron–carbon materials at high temperatures in TEXTOR, *V. Philipps, A. Pospieszczyk, U. Samm, J. Winter, H.G. Esser, M. Erdweg, L. Könen, J. Linke, B. Schweer, J.V. Seggern, B. Unterberg, E. Vietzke and E. Wallura* 1106
High temperature erosion of boron/carbon materials, *E. Vietzke, V. Philipps and K. Flaskamp* 1112
Rhombohedral pyrolytic boron nitride as a protection material in fusion devices, *O.I. Buzhinskij, V.V. Lopatin and B.N. Sharupin* 1118
On gas pumping by using superpermeable membranes in ITER, *A.Yu. Pigarov, V.I. Pistunovich and A.I. Livshits* 1121
Effects of ionizing scrape-off layers on local recycling in Tore Supra pump limiter experiments, *L.W. Owen, M. Chatelier, J.T. Hogan, C.C. Klepper, T. Loarer, P.K. Mioduszewski and T. Uckan* 1125
Implantation and desorption of tritium and tritium recovery from the JET neutral beam injectors, *H.D. Falter, E. Thompson, D. Ćirić and H.P.L. de Esch* . 1131
Laser-induced fluorescence measurements of electric field distribution in the plasma edge, *H. Sakai, K. Takiyama, M. Kimura, M. Yamasaki, T. Oda and K. Kawasaki* 1135
Thermal diffusivity of boron–carbon–titanium compounds as plasma facing materials, *T. Shikama, T. Tanabe, M. Fujitsuka, A. Ono, T. Baba and H. Shinno* 1140

List of participants 1145

Author index 1149

Subject index 1171